

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

What is claimed is:

1. (Currently Amended) A rotor assembly for an electric motor, the rotor assembly comprising:

a spoke permanent magnet rotor having an axis of rotation, and comprising a single body of permanent magnet material continuously circumferentially surrounding the axis of rotation to define a circumferential portion, and continuously radially extending outwardly relative to the axis of rotation to form a plurality of outwardly extending portions, the circumferential portion defining a first interface surface, and ferro-magnetic material positioned adjacent to the outwardly extending portions of permanent magnet material and including an outer surface and a second interface surface formed inward of the outer surface that engages the first interface surface, the first interface surface and second interface surface arranged to inhibit outward radial motion of the ferro-magnetic material; and
a shaft supporting the spoke permanent magnet rotor for rotation about the axis of rotation.

2. (Original) A rotor assembly as claimed in claim 1 wherein the outwardly extending portions of permanent magnet material extend radially outward to the perimeter of the spoke permanent magnet rotor.

3. (Original) A rotor assembly as claimed in claim 1 wherein the ferro-magnetic material includes ferro-magnetic laminations.
4. (Original) A rotor assembly as claimed in claim 1 wherein the ferro-magnetic material includes ferro-magnetic powder compacted using a compaction process.
5. (Original) A rotor assembly as claimed in claim 1 wherein the permanent magnet material includes permanent magnet powder compacted using a compaction process.
6. (Original) A rotor assembly as claimed in claim 1 wherein the ferro-magnetic material includes ferro-magnetic powder compacted using an electromagnetic compaction process, and wherein the permanent magnet material includes permanent magnet powder compacted simultaneously with the ferro-magnetic powder using the electromagnetic compaction process.
7. (Currently Amended) A rotor assembly as claimed in claim 1 wherein the ferro-magnetic material forms a plurality of pole pieces, and wherein the permanent magnet material includes plastic bonded permanent magnet material ~~injection~~ molded around the pole pieces.

8. (Original) A rotor assembly as claimed in claim 1 wherein the ferro-magnetic material forms a plurality of pole pieces, and wherein each of the plurality of pole pieces includes an interface surface that prevents movement between the respective pole piece and the permanent magnet material adjacent to the respective pole piece.

9. (Original) A rotor assembly as claimed in claim 8 wherein the interface surface includes a dovetail interface surface that forms a dovetail.

10. (Original) A rotor assembly as claimed in claim 8 wherein the interface surface includes a recess interface surface that forms a recess having a main portion and a throat portion, and wherein the throat portion is narrower than the main portion.

11. (Original) A rotor assembly as claimed in claim 1 wherein the axis of rotation extends through the permanent magnet material.

12. (Currently Amended) A rotor assembly as claimed in claim 56 ~~claim 1~~ wherein the shaft includes a first stub shaft and a second stub shaft, the first and second stub shafts each having an axis of rotation collinear with the axis of rotation of the spoke permanent magnet rotor, wherein the spoke permanent magnet rotor includes a first end and a second end, and wherein the first stub shaft is connected to the first end and the second stub shaft is connected to the second end.

13. (Original) A rotor assembly as claimed in claim 12 wherein the shaft also includes a first end plate and a second end plate, wherein the first end plate is connected to the first end between the spoke permanent magnet rotor and the first stub shaft, and wherein the second end plate is connected to the second end between the spoke permanent magnet rotor and the second stub shaft.

14. (Original) A rotor assembly as claimed in claim 1 wherein the circumferentially surrounding portion of permanent magnet material extends from a first radial position to a second radial position spaced from and outward of the first radial position, wherein the first radial position is positioned substantially adjacent the axis of rotation, and wherein the second radial position is positioned substantially adjacent the radially innermost portion of ferro-magnetic material.

15. (Original) A rotor assembly as claimed in claim 1 wherein the circumferentially surrounding portion of permanent magnet material extends from a first radial position to a second radial position spaced from and outward of the first radial position, wherein the first radial position is spaced from the axis of rotation, and wherein the second radial position is positioned substantially adjacent the radially inner most portion of ferro-magnetic material.

16. (Cancelled)

17. (Original) A rotor assembly as claimed in claim 15 wherein the first radial position is positioned substantially adjacent to an outermost portion of a hollow portion, and wherein the axis of rotation extends through the hollow portion.

18. (Original) A rotor assembly as claimed in claim 15 wherein the first radial position is positioned substantially adjacent to an outermost portion of a core portion, wherein the axis of rotation extends through the core portion, and wherein the core portion includes at least one of a magnetic material and a non-magnetic material.

19. (Currently Amended) A rotor assembly for an electric motor, the rotor assembly comprising:

a permanent magnet rotor having an axis of rotation, a portion of permanent magnet material that substantially surrounds a portion of the axis of rotation and includes at least a portion that is not magnetized ~~has a first magnitude of magnetization~~, a plurality of angularly spaced spoke portions of permanent magnet material extending that extend outwardly from the portion of permanent magnet material and are magnetized ~~having a second magnitude of magnetization different from the first magnitude of magnetization~~, and ferro-magnetic material positioned between the angularly spaced spoke portions of permanent magnet material; and

a shaft supporting the permanent magnet rotor for rotation about the axis of rotation.

20. (Original) A rotor assembly as claimed in claim 19 wherein the center portion of permanent magnet material includes a hollow portion, and wherein the axis of rotation extends through the hollow portion.

21. (Cancelled)

22. (Original) A rotor assembly as claimed in claim 19 wherein the center portion of permanent magnet material surrounds a core portion, wherein the axis of rotation extends through the core portion, and wherein the core portion includes a non-magnetic material.

23. (Original) A rotor assembly as claimed in claim 19 wherein the center portion of permanent magnet material is solid.

24. (Original) A rotor assembly as claimed in claim 19 wherein the permanent magnet material and the ferro-magnetic material have an interface therebetween that prevents the ferro-magnetic material adjacent to the interface from moving outwardly during rotation of the spoke permanent magnet rotor about the axis of rotation.

25. (Currently Amended) A rotor assembly as claimed in claim 19 wherein for an electric motor, the rotor assembly comprising:

~~a spoke permanent magnet rotor having an axis of rotation, permanent magnet material having a portion that substantially surrounds a portion of the axis of rotation and has a first magnitude of magnetization and portions extending outwardly relative to the axis of rotation to form a plurality of outwardly extending spoke portions of permanent magnet material and having a second magnitude of magnetization different from the first magnitude of magnetization, the permanent magnet material includes including permanent magnet powder compacted using an electromagnetic compaction process, and ferro-magnetic material positioned adjacent to the outwardly extending spoke portions of permanent magnet material; and~~

~~a shaft supporting the spoke permanent magnet rotor for rotation about the axis of rotation.~~

26. (Currently Amended) A rotor assembly as claimed in claim 19 ~~claim 25~~ wherein the shaft includes a through-shaft assembly having a magnetic through-shaft and a non-magnetic sleeve surrounding at least a portion of the magnetic through-shaft, and wherein the outwardly extending spoke portions of permanent magnet material extend radially outward from the non-magnetic sleeve.

27. (Original) A rotor assembly as claimed in claim 25 wherein the ferro-magnetic material includes ferro-magnetic powder compacted simultaneously with the permanent magnet powder using the electromagnetic compaction process.

28. (Currently Amended) A rotor assembly as claimed in claim 19 ~~claim 25~~ wherein the permanent magnet material circumferentially surrounds the axis of rotation to form a circumferentially surrounding portion of permanent magnet material.

29. (Original) A rotor assembly as claimed in claim 28 wherein the axis of rotation passes through the permanent magnet material.

30. (Currently Amended) A rotor assembly as claimed in claim 19 ~~claim 25~~ wherein the permanent magnet material forms a center portion of permanent magnet material, and wherein the outwardly extending spoke portions of permanent magnet material extend radially outward from the form the center portion of permanent magnet material.

31. (Currently Amended) A rotor assembly as claimed in claim 19 ~~claim 25~~ wherein bolts do not extend through the ferro-magnetic material.

32. (Cancelled)

33. (Currently Amended) A rotor assembly for an electric motor, the assembly comprising:

a spoke permanent magnet rotor having an axis of rotation, permanent magnet material having a portion that continuously surrounds a portion of the axis of rotation to define a circumferential portion, and portions extending outwardly relative to the axis of rotation to form a plurality of outwardly extending spoke portions of permanent magnet material, the permanent magnet material defining a plurality of interface surfaces, each interface surface disposed between adjacent outwardly extending spoke portions, and ferro-magnetic material forming a plurality of pole pieces, each pole piece being positioned between a set of circumferentially adjacent outwardly extending spoke portions of permanent magnet material and including a pole interface surface engageable with one of the plurality of interface surfaces to inhibit outward radial movement of the pole piece, the permanent magnet material including injection molded plastic bonded permanent magnet material; and

a shaft supporting the spoke permanent magnet rotor for rotation about the axis of rotation.

34. (Currently Amended) A rotor assembly as claimed in claim 33 wherein the plastic bonded permanent magnet material is injection molded around the pole pieces in an injection molding process.

35. (Original) A rotor assembly as claimed in claim 33 wherein at least one pole piece includes an interface surface that prevents movement between the at least one pole piece and the permanent magnet material adjacent to the at least one pole piece.

36. (Original) A rotor assembly as claimed in claim 33 wherein the permanent magnet material circumferentially surrounds the axis of rotation to form a circumferentially surrounding portion of permanent magnet material.

37. (Original) A rotor assembly as claimed in claim 36 wherein the axis of rotation passes through the permanent magnet material.

38. (Original) A rotor assembly as claimed in claim 33 wherein the permanent magnet material forms a center portion of permanent magnet material, and wherein the outwardly extending spoke portions of permanent magnet material extend radially outward from the center portion of permanent magnet material.

39. (Original) A rotor assembly as claimed in claim 33 wherein bolts do not extend through the pole pieces.

40-42. (Cancelled)

43. (Previously Presented) The rotor assembly as claimed in claim 1 wherein the permanent magnet material circumferentially surrounding the axis of rotation is not magnetized and the permanent magnet material extending substantially radially relative to the axis of rotation is magnetized.

44. (Previously Presented) The rotor assembly as claimed in claim 1 wherein the permanent magnet material circumferentially surrounding the axis of rotation directly contacts the shaft.

45-46. (Cancelled)

47. (Previously Presented) The rotor assembly as claimed in claim 19 wherein the permanent magnet material circumferentially surrounding the axis of rotation directly contacts the shaft.

48-49. (Cancelled)

50. (Previously Presented) The rotor assembly as claimed in claim 25 wherein the permanent magnet material circumferentially surrounding the axis of rotation directly contacts the shaft.

51. (Cancelled)

52. (Currently Amended) The rotor assembly as claimed in claim 33 wherein ~~the magnitude of the magnetization of~~ the portion of permanent magnet material that continuously surrounds a portion of the axis of rotation includes at least a portion that is not magnetized, and different than the magnitude of the magnetization of the outwardly extending portions of permanent magnet material are magnetized.

53. (Cancelled)

54. (Previously Presented) The rotor assembly as claimed in claim 33 wherein the permanent magnet material circumferentially surrounding the axis of rotation directly contacts the shaft.

55. (Cancelled)

56. (New) A rotor assembly as claimed in claim 1 further comprising a shaft supporting the spoke permanent magnet rotor for rotation about the axis of rotation.

57. (New) A rotor assembly as claimed in claim 8 wherein the ferro-magnetic material defines a plurality of separate pole pieces.

58. (New) A rotor assembly as claimed in claim 19 wherein the spoke portions are tangentially magnetized.

59. (New) A rotor assembly as claimed in claim 19 wherein the spoke portions extend to an outer perimeter of the rotor.

60. (New) A rotor assembly as claimed in claim 19 wherein the ferro-magnetic material defines a plurality of separate pole pieces.

61. (New) A rotor assembly as claimed in claim 27 wherein the electromagnetic compaction process produces a composite structure.

62. (New) A rotor assembly as claimed in claim 33 wherein the plurality of pole pieces are separate from one another.

63. (New) A rotor assembly as claimed in claim 52 wherein the spoke portions are tangentially magnetized.

64. (New) A rotor assembly for an electric machine having an axis of rotation, the rotor assembly comprising:

a single body of permanent magnet material defining a circumferential portion that surrounds the axis of rotation and includes a substantial portion that is not magnetized, and a plurality of spoke portions extending radially outward from the circumferential portion, each of the spoke portions being tangentially magnetized;

a plurality of pole pieces, each disposed between two adjacent spoke portions and coupled to the permanent magnet material such that the permanent magnet material inhibits the outward radial movement of the pole pieces; and

a core portion disposed within the circumferential portion.

65. (New) A rotor assembly as claimed in claim 64 wherein the pole pieces are separate.

66. (New) A rotor assembly as claimed in claim 65 wherein the spoke portions extend to an outer perimeter of the rotor.

67. (New) A rotor assembly as claimed in claim 65 wherein the pole pieces are coupled to both the circumferential portion and the adjacent spoke portions.

68. (New) A rotor assembly as claimed in claim 67 further comprising a shaft with an axis coinciding with the longitudinal axis of the circumferential portion or the body of permanent magnet material.

69. (New) A rotor assembly as claimed in claim 67 wherein the permanent magnet material and the pole pieces are attached to one another using a dynamic magnetic compaction process to define a composite rotor.

70. (New) A rotor assembly as claimed in claim 67 wherein the permanent magnet material includes a molded plastic portion bonded with the pole pieces.